

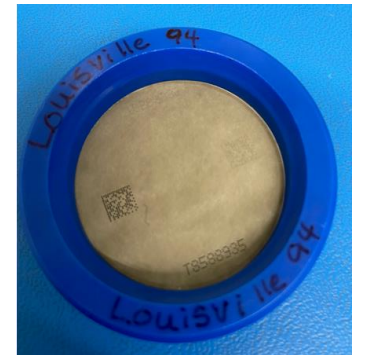
APCD PM_{2.5} Monitoring Methods

Louisville Air Pollution Control District
July 21, 2021



Federal Reference Method (FRM)

- Sampler draws ambient air at a constant volumetric flow rate through a specially shaped inlet and inertial particle size separator to collect particles ≤ 2.5 microns onto a filter
- Each filter weighed before and after sampling. This requires a specialized laboratory
- FRMs Comprised entire LMAPCD PM_{2.5} regulatory network for over a decade
 - Limited technology but reliable instruments
 - One 24-hr measurement every 3 days (non-continuous)
 - Expensive and laborious quality assurance requirements



Federal Equivalent Methods

- Met One BAM 1020
 - Beta Attenuation Method - employing the absorption of beta radiation by solid particles extracted from air flow and measured on a glass fiber filter tape.
 - Introduced to LMAPCD network in 2010.
 - Provides hourly PM_{2.5} concentrations and could be utilized for the Air Quality Index as well as regulatory monitoring.
 - Initially easy to operate, but ...
 - Found some variability in data between like instruments
 - Required lengthy background tests to adjust for noise
 - Some issues with filter tape



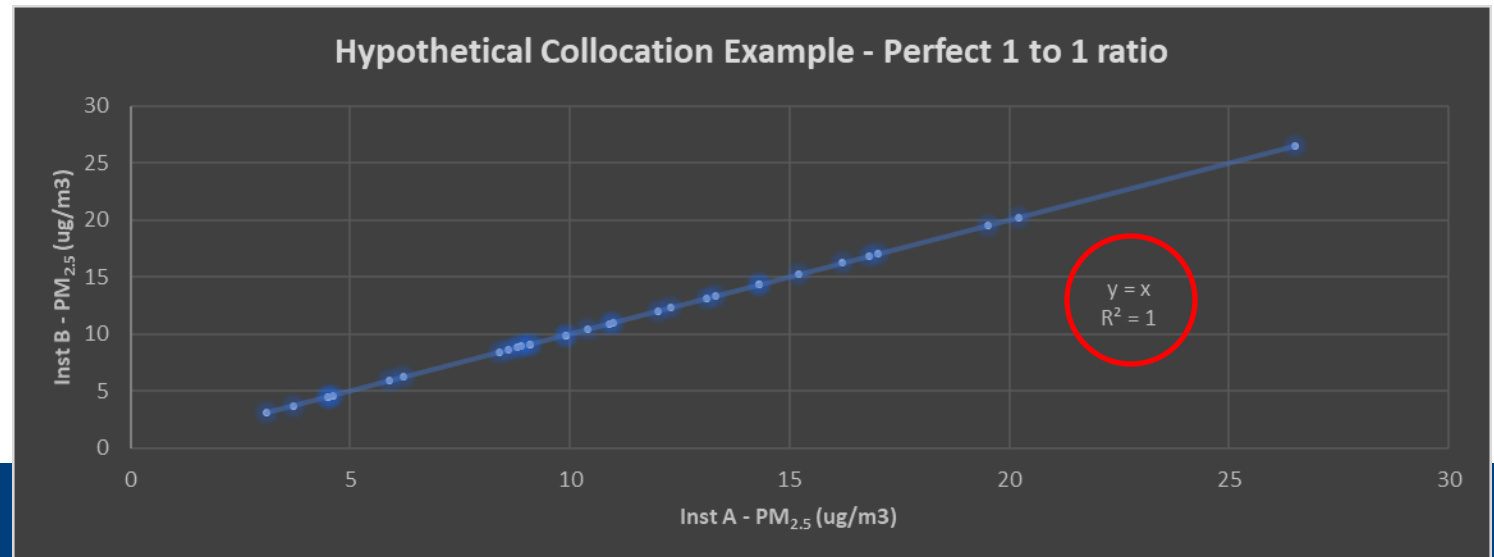
Federal Equivalent Methods

- API Teledyne T640(x)
 - Measures PM mass using scattered light spectrometry
 - Introduced to LMAPCD network in 2018.
 - Provides continuous PM_{2.5} concentrations and could be utilized for the Air Quality Index as well as regulatory monitoring.
 - Can even provide sub-hourly PM concentrations (e.g. 1-minute averages)
 - Does not require background (noise) testing.
 - Easier to operate than FRM and BAM, but does contain its own operational challenges

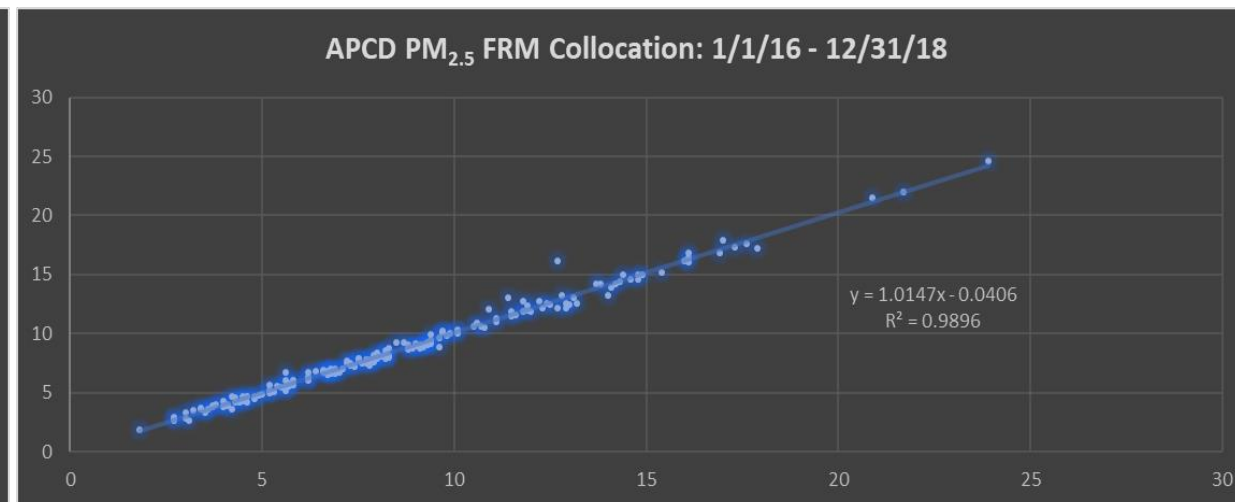
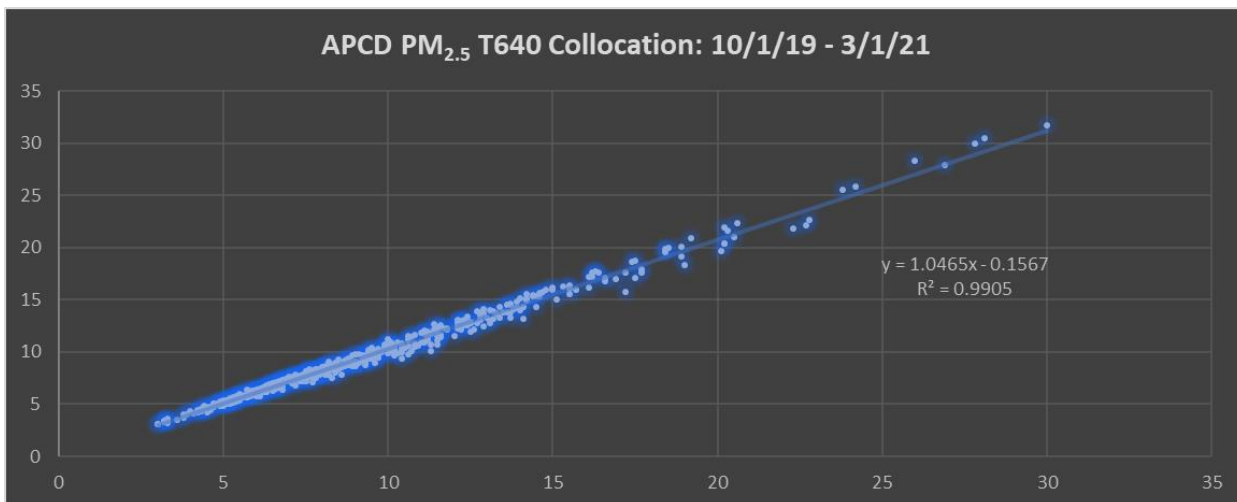
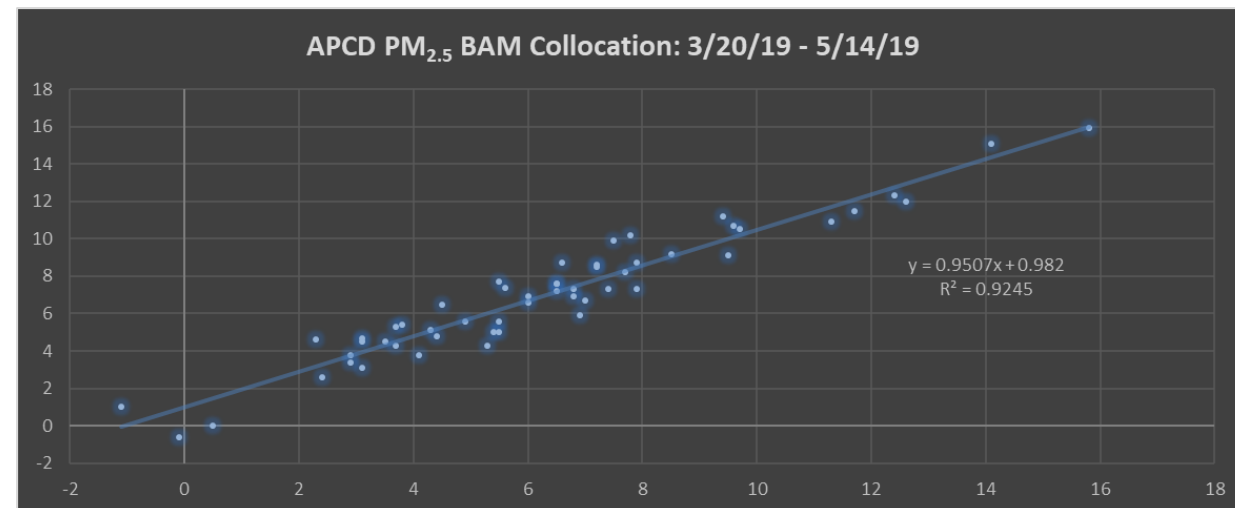


Assessing Particulate Matter Methods

- Collocation
 - Refers to the operation of particulate instruments side by side to assess the repeatability / variability of the data to evaluate the precision of the method
 - Required for quality assurance purposes, but APCD has performed additional collocation studies to better evaluate methods



APCD PM_{2.5} Collocation Results

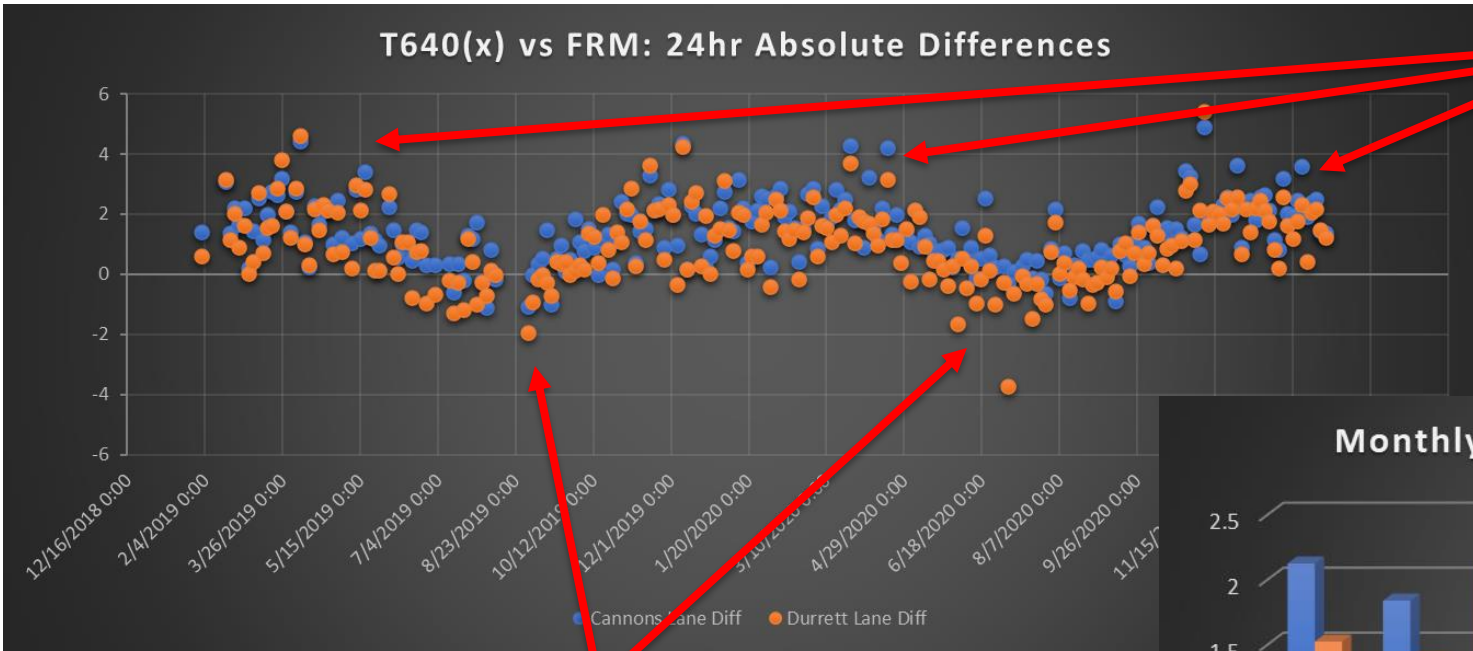


PM_{2.5} Collocation Results Summary

- T640 collocation results show excellent repeatability
- T640 repeatability / precision in line with FRM method
- T640 combines the reliability of the FRM method with the BAM 1020's continuous nature and ease of use
- While T640(x) precision seems to be excellent, there are some seasonal differences between T640 and FRM data

T640(x) vs FRM Collocation

T640(x) vs FRM: 24hr Absolute Differences

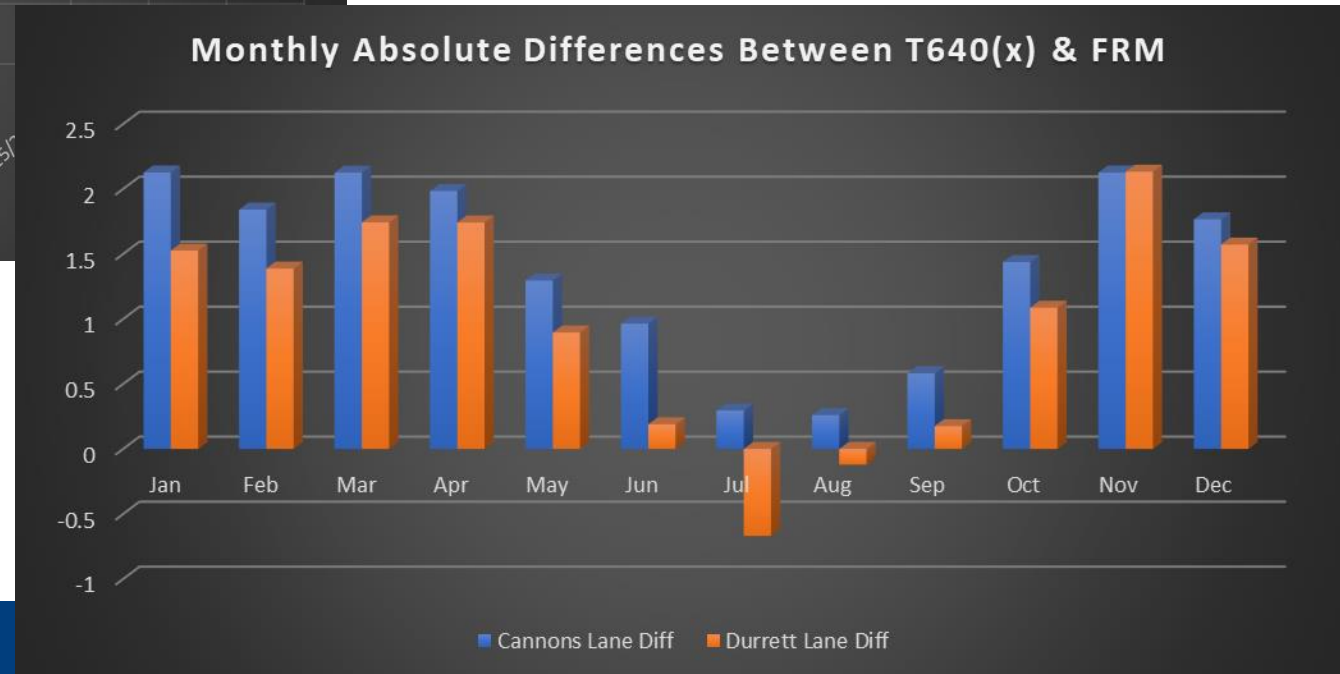


T640(x) 1.5 to 2.0 $\mu\text{g}/\text{m}^3$ higher on average during the cool, dry season

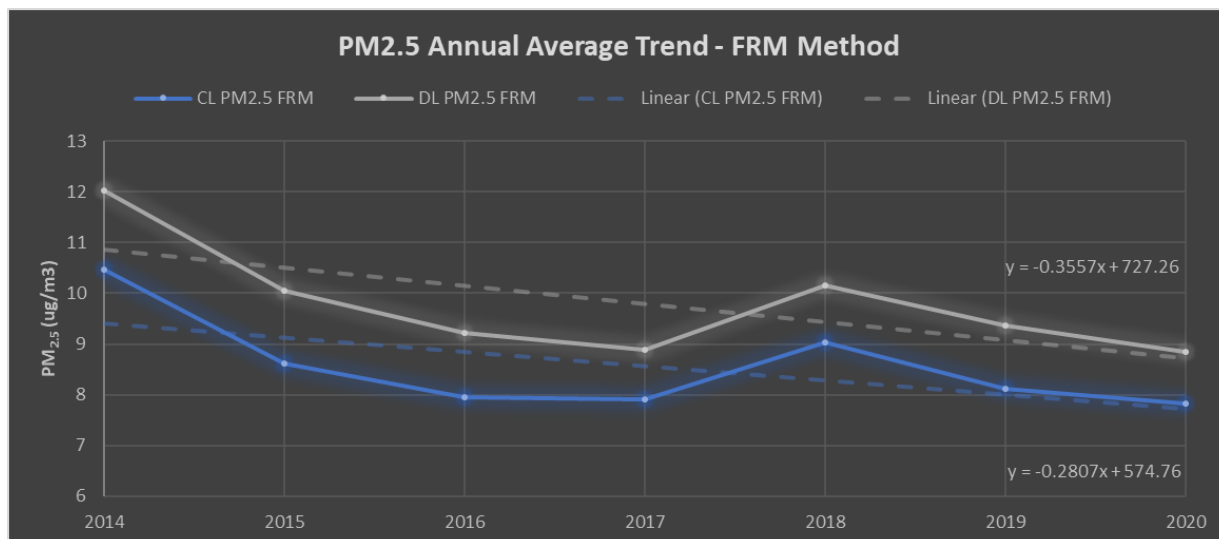
- On average, T640(x) 1-2 $\mu\text{g}/\text{m}^3$ higher (relative to FRM)

T640(x) just about equal to FRM during warm / humid season

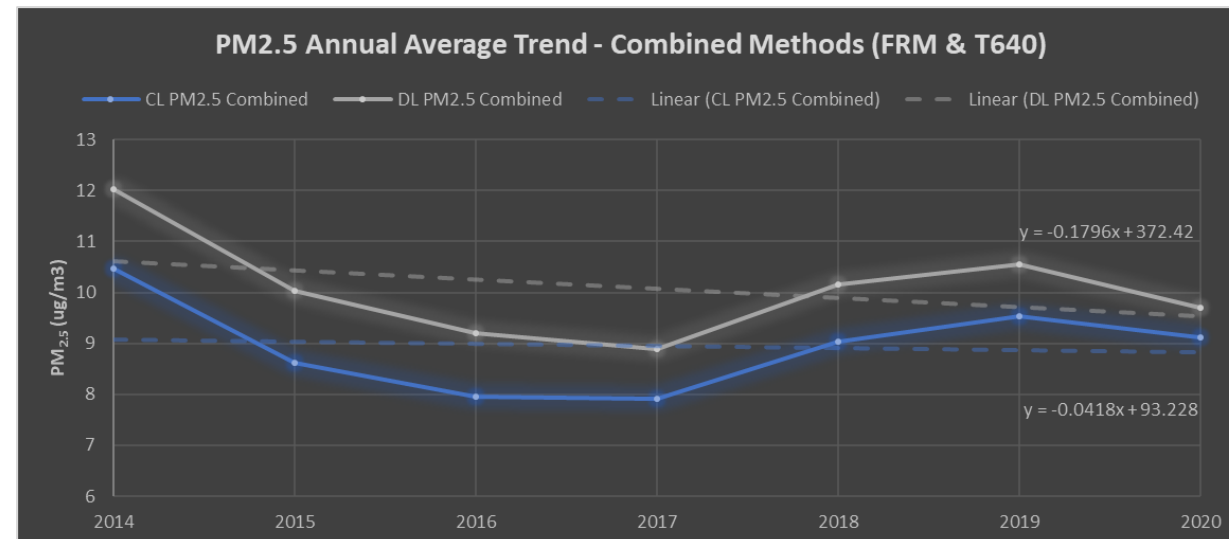
Monthly Absolute Differences Between T640(x) & FRM



Interpreting PM_{2.5} Trends



FRM data show a reduction in PM_{2.5} of about 2 µg/m³ over the last 7 years



When combining FRM & T640* data, the PM_{2.5} reduction is about 1 µg/m³ over the last 7 years

Summary & Takeaways

- APCD has evaluated several different particulate monitoring methods over the years and transitioned from FRMs to continuous methods
- The FRMs and T640s have shown the best repeatability / precision
- T640s provide several advantages over the older FRM method
 - Greater temporal representativeness (i.e. data available from all days)
 - Better understanding of diurnal profiles for particulate
 - Better understanding of the impact of short term spikes in PM on the 24-hour average
 - Ability to more easily relate changes in PM concentrations to meteorological events or emissions events
- Some differences in data do exist between T640s and FRMs
 - Some debate within air monitoring community regarding which method is more accurate
- Changes in monitoring methods can have a small impact on assessing trends

Questions

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